Methamphetamine and the Pediatric Patient

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Children living in meth labs are often found dirty, pale, lethargic and unhappy. Delayed verbal skills are common. This particular three-year-old slept in the same area meth was being cooked. Not surprisingly, she and her sibling tested positive for meth.

The stimulant drug methamphetamine continues to be a problem drug of abuse. California is a major center for trafficking and production of methamphetamine. Adolescents' methamphetamine use, and the exposure of younger children to the dangers of in-home methamphetamine laboratories, may have serious consequences. This article addresses the current problems of illicit methamphetamine in pediatrics.

According to the National Sheriff's Association, methamphetamine (MA) is the number one illicit substance abuse problem in the United States. The Drug Enforcement Agency (DEA) believes MA to be the greatest drug threat in California. Predominant sources of MA in the United States are from clandestine laboratories in Mexico and California, especially the Central Valley. The primary point of entry from Mexico is in California, especially San Ysidro. Border seizures increased from 6.5 kg in 1992 to 1370 kg in 2001[1].

Methamphetamine is similar to amphetamine, which was first produced in 1887 by Edeleano, a German Chemist[2]. MA was first made from ephedrine by a Japanese pharmacologist in 1893. In the 1930s, amphetamine began to be used to treat asthma, narcolepsy, hyperactivity in children, and suppression of appetite. MA's use increased during World War II when it was used by militaries to enhance performance and endurance of soldiers. After the war, surplus supplies of MA became available to civilian populations, and the "First Epidemic" developed in Japan[3].

In the United States, amphetamine was available over the counter until 1959. Prescription use peaked in 1967. Concurrently in the 1960s, liquid MA use began as a treatment for heroin addiction and intravenous MA use began. Most of the illicit MA was illegally obtained from pharmaceutical supplies. However, in 1962, when the drugs were removed from the pharmaceutical market, illicit laboratories developed in San Francisco. Initially, motorcycle gangs were the predominant users, but use quickly spread to include college students and young professionals[3].

As more legal restrictions developed, use and production began to increase in the San Diego area, with increased trafficking of MA and precursor chemicals from Mexico in the 1980s. Similarly, Hawaii experienced an increase in use and trafficking from Asia. In 1996, MA lab seizures increased 169%, fueling the Comprehensive Methamphetamine Control Act[3]. This act increased penalties for trafficking and manufacturing of MA[4].

Although methamphetamine may still be used to treat ADHD, this article will focus on the illicit use, abuse, and manufacturing of MA. Within the pediatric population, patients may be users, or patients may be affected by a MA lab within the home. This paper will explore these effects and how to help affected patients.

Pharmacology & Toxicology

Amphetamines are central nervous system stimulants of the sympathetic and euphoric pathways[5]. Methamphetamine has proportionately more central effects than amphetamine and greater subjective effects[6]. Increased central nervous system effects are likely due to prolonged half-life and increased penetration of the blood-brain barrier[7]. The effects of MA are produced by stimulating release of dopamine, serotonin and norepinephrine[8]. Furthermore, the presynaptic reuptake of dopamine, norepinephrine, and serotonin are blocked, potentiating the effects[7]. It may be ingested orally, intravenously, nasally, or inhaled (smoked). The peak effects are dependent on route of administration, with inhalation and injection being almost instantaneous. The half-life ranges from 10-30 hours[4]. MA undergoes a CYP dependent metabolism (liver metabolism by the cytochrome P450 system)[9].

Methamphetamine effects can include increases in activity, alertness, restlessness, self-esteem, sexuality, temperature, heart rate, and blood pressure, while decreasing appetite. Acute and chronic toxic effects can be observed on the cardiovascular, neurological, pulmonary, renal, and hepatic systems. Toxic effects are based on dose, quantity and frequency. More frequent and heavy users are at risk for cardiomyopathy, hypotension and hypertension, ischemia, thrombi, aortic dissections, and arterial aneurysms. MA is known to induce hyperthermia, muscle hyperactivity, metabolic acidosis, secondary rhabdomyolysis, and renal failure. Pulmonary complications include respiratory distress with possible noncardiogenic pulmonary edema and pulmonary hypertension. Patients may be anxious, agitated, hallucinating, confused, paranoid, psychotic, or suffering from seizures or a stroke[7]. Methamphetamine psychosis has been described as presenting with symptoms similar to schizophrenia. One study of 445 amphetamine users in a psychiatric hospital and detention center in Taipei correlated MA induced psychosis with escalating dose, younger age at first use, and increased prevalence of pre-existing major depressive disorder, antisocial personality disorder, and alcohol dependence[5]. Length of MA use and degree of psychosis has been inversely correlated with decreased density of dopamine transporters in the nucleus accumbens, caudate, and putamen[10].

Production & Distribution

The production of methamphetamine is commonly referred to as "cooking." When illicit laboratories were first developed, MA was produced using phenyl-2-propanone (P2P) and methylamine as primary precursors[11]. After P2P was placed under federal control in 1988, the primary precursor changed to ephedrine or pseudoephedrine[2]. There are two common methods utilizing ephedrine. The NAZI method (birch reduction) utilizes anhydrous ammonia and lithium, while the cold process (red phosphorous) employs iodine and red phosphorous. As the supply of pseudoephedrine from Canada has decreased significantly, the supplies of ephedrine and pseudoephedrine from China have risen in response[1]. The equipment necessary to create a crude lab is commonly found within most households and includes Pyrex containers, mason jars, soda bottles, foil, thermos containers, hot plates and pails[12].

In 2002, 7500 laboratories were seized[13]. Laboratories are found in cars, trailers, apartments, homes and motel rooms[14]. Although MA labs are located in many different places, there are some common clues to production. Precautions are often taken for security measures by producers of MA, such as fences and signs, but also dark curtains or aluminum foil covering the windows. Unique to MA labs is the chemical smell that may be evident and the waste produced, especially red stained coffee filters[13].

There are many potential negative consequences of MA production. The chemicals themselves are corrosive, explosive, flammable, and toxic. The risk of exposure is increased especially with many amateur chemists, and lack of adequate ventilation and equipment found in many small laboratories. The effects of acute exposure depend upon the route, i.e. inhalation, oral ingestion, or skin contact, and include burning of the skin and eyes, conjunctivitis, corneal injury, lacrimation, coughing, chest pain, shortness of breath, pulmonary edema, hemoptysis, nausea, dizziness, headache, anxiety and lethargy[11].

Because there are many toxic chemicals used in the production and toxic byproducts that are formed during production, the issue of cleanup has become significant. For every pound of methamphetamine produced, up to five pounds of waste is generated. The cost of clean-up is approximately $2000-$3000 per lab[1]. During clean-up, recommended minimal protective equipment includes protective eye wear, disposable gloves, and a disposable jumpsuit. All substances and equipment used for production must be properly disposed of to minimize the risk of ground water contamination. As the volatile chemicals are readily absorbed in ceiling tiles, wallboards, curtains, carpeting, and furniture, it is usually recommended that these are discarded. The remainder of the space must be sufficiently aired out, scrubbed and re-painted. Demolition is occasionally necessary[12].

In 2004, 786.5 kg of methamphetamine was seized in California, 474 kg of which was from lab seizures. Although lab seizures in California have decreased in recent years, the seizures in other states of methamphetamine originating or traversing California have not declined. Furthermore, the availability of MA in California has not decreased over this period[1].

Use

Common street names of methamphetamine vary according to route of administration and geographical location[12]. They include speed, crank, crystal meth, meth, CR, wire, biker's coffee, glass, poor man's cocaine, shabu, stove top, trash, go, or ice[2]. Ice is the most common name for inhaled MA and is more commonly used in Hawaii. Estimates for lifetime use in the United States' population in 2002 was 5.3%[12]. Studies demonstrated regional differences specific to California, where snorting was the primary route of ingestion in Los Angeles and San Diego, while injection was more prevalent in San Francisco[1].

The 2005 Monitoring the Future data found that 3.1% of 8th graders, 4.1% of 10th graders, and 4.5% of 12th graders had ever used MA[15]. In the 2003 Youth Risk Behavior Surveillance data, use was slightly greater in males. Only 3.1% of African American students reported use, versus 8.3% of Hispanic students and 8.1% of Caucasian students[16]. (MMWR, May 21, 2004, Volume 53, No. SS-2). Surveys of specific California school districts show lifetime use slightly greater than the national average, with lifetime use in 9th-12th graders of 7.6% in San Diego, 8.0% in Los Angeles, and 8.5% in San Bernardino[16].

MA is typically used in "binges." Users ingest approximately 100mg MA every 4-6 hours for 24-48 hours or longer[8]. After being high for days without sleep, symptoms of paranoia, agitation, depression, and anxiety increase towards the end of the binge and also during withdrawal. After a binge, a user may sleep for 24-36 hours[8]. With chronic use, violent behavior, anxiety, confusion, paranoia, delusions, and hallucinations are commonly observed. Outward physical changes include weight loss, poor dentition, and scars and open sores frequently secondary to formication (an abnormal sensation as of insects running over or into the skin, associated with cocaine intoxication or disease of the spinal cord and peripheral nerves). Once the user is no longer able to achieve the same high, the "tweaking phase" begins. During this period, extreme measures may be taken to attain the high, including use of other drugs[12].

Methamphetamine Risk in Pediatric Populations

The risks to pediatric populations are considerable. In utero exposure increases the risk of low birth weight, prematurity, and fetal distress. If the MA was contaminated with lead, permanent brain damage may result. Although the first year of life of a drug-exposed fetus may be complicated by lethargy, poor feeding, vomiting, and tremors, with consistent reliable care, the resultant development may be normal[8]. Last year, in 20% of the MA labs seized, children were present and therefore at risk for direct exposure to the hazardous chemicals[1]. In a study of 132 children reportedly exposed to methamphetamine labs, 45% of hair samples were positive for illicit drugs. Methamphetamine accounted for 62% of the positive samples[17].

The social consequences are also significant, including neglect or abuse. With the typical pattern of binge use, supervision is often poor during binges and crashes. This can result in forgotten meals for younger children and increased responsibility for adolescents of their younger siblings. The practice of using benzodiazepines and/or benadryl in an attempt to sedate children during binges or crashes has been reported. Aside from the potential toxic and volatile exposures inherent in MA production, user paranoia frequently leads to acquisition of weapons and development of booby-traps to protect the lab. With increased violent activity during MA use, the accessibility of weapons becomes even more dangerous for children in the home[17].

The increased sexuality induced during methamphetamine use creates the further potential of harm to children. When labs are seized, it is common to find pornographic material about the lab accessible by children. Furthermore, when adults are actively using, children are at risk to incur sexual abuse, especially if sedated[17]. Risks of hypersexuality experienced by users of MA may lead to uncharacteristic sexual behaviors including survival sex[7], sex with prostitutes, and increased HIV high-risk behaviors in heterosexual, homosexual, and bisexual users[4].

Treatment

In the pediatric population, consideration must be given regarding treatment for patients who are exposed to clandestine methamphetamine labs, and patients who use methamphetamine. Clues of exposure to MA labs include signs of neglect, abuse, burns, and an odor of clothes permeated by chemicals. Protocols have been established[17] for children found to be living in homes where a MA lab was discovered. The initial evaluation includes assessment for symptoms including uncontrolled movements, respiratory distress, and neurologic compromise. Then assurance of decontamination is made, followed by appropriate treatment and collection of hair or urine to assess for MA exposure[17]. Some patients with lab exposure may present with burns. They also may have experienced more inhalational injuries, therefore requiring more respiratory support and longer periods of ventilation assistance[2].

Treatment for the patient with acute MA intoxication is predominately supportive. This may include respiratory support, aborting seizure activity and arrhythmias, blood pressure support, and electrolyte stabilization. For agitation, benzodiazepines may be used acutely. Acidification of urine has been proposed to increase urinary clearance of MA, however this is not recommended as rhabdomyolysis may be exacerbated[7].

The final consideration is treating patients who use MA but are not acutely intoxicated. This is an opportunity to provide preventative care and counseling. Motivational interviewing techniques may be used to assess patient's desire to stop using. Typical treatments consist of psychosocial and behavioral components. The Matrix Model, which incorporates cognitive behavioral therapy with education, family

Continued on page 20

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involvement, 12-step programs, and positive reinforcement, has shown similar results at six months[18]. History of high risk behaviors should be obtained and screening for HIV, STIs, and Hepatitis should be carried out when relevant. Finally, time should be spent on family planning and needle safety education.

Conclusions

Methamphetamine use and production poses many risks within the pediatric population. Adolescents may begin with experimentation which may lead to addiction and many high risk behaviors. The younger pediatric patient may be exposed to harmful chemicals or be at risk for abuse and neglect. The practitioner should be aware of these potential risks in an effort to effectively screen for risk and provide appropriate anticipatory guidance and preventative care.

Web Resources

Substance Abuse and Mental Health Administration: *www.samhsa.gov*

National Institute of Drug Abuse: *www.nida.nih.gov*

California: *www.ca.gov/* (type in "methamphetamine" in search box)

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